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FOUR NEW SPECIES OF SPIONIDAE (POLYCHAETA) FROM NEW ZEALAND, WITH COMMENTS ON A SYNTYPE OF *SPIO AEQUALIS* EHLERS FROM CHATHAM ISLAND

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Abstract.—Four new species of Spionidae are described from New Zealand. *Microspio maori* is a widespread intertidal species occurring on both of the main islands. *Microspio elegantula* occurs intertidally in Wellington Harbor. *Spio readi* occurs in the intertidal zone of Wellington Harbor and from 50–105 m off the Otago Peninsula of South Island. *Carazziella proberti* closely resembles two Australian species and occurs off Otago in 122 m. *Spio aequalis* Ehlers is known only from its original find on Chatham Island. The syntype bears unusually large posterior branchiae.

Recent ecological studies of benthic habitats in offshore areas, shallow water embayments and estuarine systems of both North and South Islands of New Zealand have catalogued numerous species of polychaetes, many of which are new to science.

The present paper describes four new species of Spionidae of the genera *Microspio, Spio,* and *Carazziella.* No species of *Microspio* and *Spio* have previously been reported from New Zealand, although several are known from Australia (Blake and Kudenov 1978). *Spio aequalis* Ehlers was originally described from Chatham Island (Ehlers 1904). In order to compare *S. aequalis* with the new collections, a syntype was obtained from the British Museum and the description is supplemented.

The most important works for identifying Spionidae of the Southern Ocean are Day (1967), Rainer (1973), Read (1975), Blake and Kudenov (1978) and Blake (1983). The genera treated in the present study follow the scheme of Blake and Kudenov (1978) and readers are referred to that work for generic diagnoses, keys and discussion of species complexes.

Type-material is deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM), and the National Museum of New Zealand, Wellington (NMNZ).

Microspio maori, new species

Fig. 1

Material examined.—NEW ZEALAND, North Island, intertidal, coll. G. B. Read: Coromandel Peninsula, Tairua Harbor, 26 Jul 1978, muddy sand, 7 paratypes (NMNZ); Pakawau Flats, Golden Bay, 11 Dec 1976, coarse sand, 30+ paratypes (NMNZ); Waikanae River Estuary, Wellington Province, 8 Oct 1978, holotype and 11 paratypes (USNM 80491–2); Pauatahanui Inlet, near Wellington, 10 Nov 1976, sand flats, 15 paratypes (NMNZ); Hutt River Estuary, Wellington, 15 Feb 1977, fine sand, 70 paratypes (USNM 80493); Ohiwa Harbor, Bay of

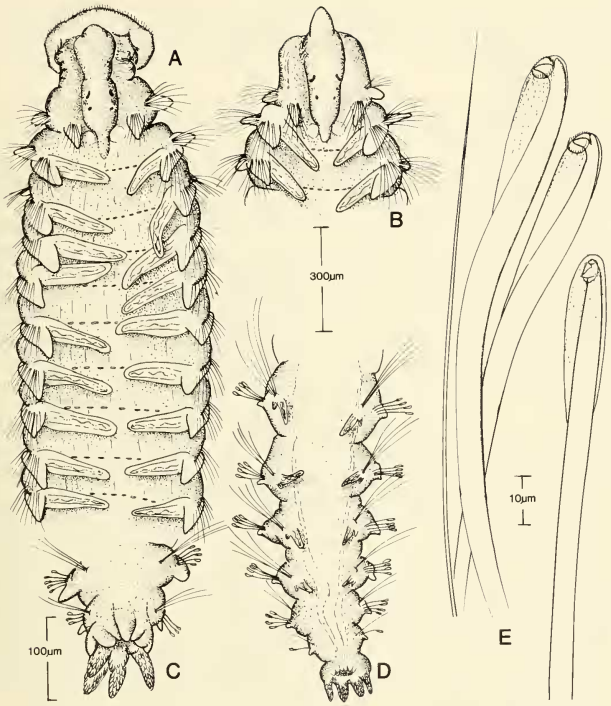

Fig. 1. *Microspio maori* (paratype, USNM 80492): A–B, Anterior ends, dorsal view, palps omitted; C–D, Posterior ends, dorsal view; E, 3 hooded hooks and accompanying capillary seta from middle neuropodium.

Plenty, 1979, intertidal sand, coll. N. Z. Ministry, Agric. & Fish., Fish. Management Division, Sta. 126, 2 juveniles (NMNZ).—NEW ZEALAND, South Island, intertidal, coll. G.B. Read: Wairau River Estuary, near Blenheim, 17 Dec 1976, fine sand, 30 specimens (NMNZ); Avon-Heathcote Estuary, Christchurch, 4 Dec 1976, fine sand, 10 specimens (USNM 80494); Waikouaiti River Estuary, Otago Peninsula, 5 Dec 1976, shelly sand, 15 specimens (NMNZ).

Description.—A long, slender species; holotype largest, 17.0 mm long and 0.5 mm wide for 75 setigers; other specimens generally smaller. Color in alcohol: light tan, with irregularly arranged black spots on posterior setigers and pygidium.

Prostomium narrow, slightly expanded anteriorly, tapering to entire tip, sometimes appearing conical (Fig. 1A, B); narrowing posteriorly to short caruncle, terminating indistinctly in middle of setiger 2; no occipital tentacle; with 2 pairs

of eyes, anterior pair cup-shaped, posterior pair oval-shaped. Peristomium well developed, slightly inflated, partly fused to setiger 1 (Fig. 1A); proboscis saclike, with heavily ciliated anterior border; palps moderately long, extending posteriorly for 9–10 setigers.

Setiger 1 biramous, well developed, with triangular notopodial postsetal lamellae and elliptical neuropodial postsetal lamellae. Branchiae from setiger 2, basally fused to notopodial lamellae, anteriorly long, straplike, extending to middorsal line (Fig. 1A), becoming shorter and narrower posteriorly (Fig. 1D); branchiae with ciliated bands on inner margins, continuing dorsally across each setiger. Anterior notopodia with lamellae large, triangular, becoming shorter and narrower, with bacillary glands in posterior setigers, but still basally fused to branchiae. Neuropodia with lamellae elliptical in anterior setigers and reduced to short glandular extensions of enlarged neuropodial lobes in posterior setigers.

Anterior parapodia with capillary noto- and neurosetae, arranged in 2 rows, setae of anterior row shorter, with fine granulations on shaft and clear narrow sheaths; setae of posterior rows longer, non-granulated. Posterior notopodia with few (5–6) very long capillary setae, with narrow sheaths. From setiger 17–19, neuropodia with hooded hooks gradually replacing both rows of capillaries, 2–3 at first with 11–12 capillaries, increasing to 9–12 hooks with 5–6 capillaries in middle setigers, with about 9 hooks and 2–3 capillaries, usually in inferiormost position in posterior setigers; hooks bidentate, with slightly recurved shaft and clear, large hood, with opening finely serrated (Fig.1E).

Pygidium with 4 equal cirri, 2 ventral and 2 ventrolateral (Fig. 1 C–D). Pygidial ciri, and noto- and neuropodial postsetal lamellae of posterior setigers with prominent bacillary glands.

Remarks.—*Microspio maori* differs from related species in having a conical-shaped prostomium, appearing almost pointed in some specimens. Related species have either a smoothly rounded prostomium or one which is distinctly incised on the anterior margin. *Microspio maori* is also unusual in the replacement pattern of the capillaries by hooded hooks. In most species the hooks replace the posterior row of capillaries, leaving the anterior row intact throughout the body. In *M. maori* the hooks entirely replace both capillary rows with a single row of hooded hooks. Accompanying capillaries are much thinner and usually limited to the lower part of the ramus. The occurrence of prominent bacillary glands in the parapodial lamellae and pygidial cirri is typical for species of *Microspio* and in this respect, *M. maori* conforms well with its congeners. The form and arrangement of the pygidial cirri, however, differs from that usually seen in species of *Spio* and *Microspio*. In *M. maori*, the 4 anal cirri are equal in size and located in the ventral half of the pygidial segment leaving a bare open ring above the anal opening. In other species, the 4 cirri are equally spaced around the anus.

Ecological notes.—*Microspio maori* is present in densities ranging from 2600–6300 per m^2 ($\bar{x}$ = 4100 per m^2) on intertidal sand flats of the Pauatahanui Inlet near Wellington. The sediments are moderately well sorted fine to very fine sands (M_z 2.9–3.3 phi) having a silt-clay content of 2–6%. Salinities range from 10–33‰. At Pauatahanui, the species is associated with a large maldanid, *Axiothella serrata* Kudenov and Read (1977), while in Wellington Harbor in organically rich, very fine sands, the most common associates are *Boccardia* spp.

Etymology.—The epithet is selected in honor of the native Maori people of New Zealand.

Distribution.—North and South Islands of New Zealand, in intertidal sandy substrata of estuaries.

Microspio elegantula, new species
Fig. 2

Material examined.—NEW ZEALAND, North Island, Wellington Harbor, Evans Bay, SW of marina, intertidal, sand and gravel, 25 Feb 1981, coll. G. B. Read, holotype (USNM 80490).

Description.—A moderate-sized species, holotype 8 mm long and 0.8 mm wide for 52 setigerous segments. Color in life: pale yellow-green, with yellow palps having prominent dark reddish brown pigment spots and numerous small, inconspicuous spots bordering ciliated groove; additional large, conspicuous brown pigment patch located mid-dorsally on prostomium and with smaller interramal spots on setigers 1–18; some white pigment present on posterior and lateral margins of peristomium. Color in alcohol: light tan, with reddish brown pigment as above; white pigment not apparent.

Prostomium broad anteriorly, with curved, slightly incised margin (Fig. 2A), gradually tapering posteriorly to narrow caruncle merging indistinctly with middle of setiger 2; 2 pairs of eyes, with anterior pair cup-shaped, widely spaced; posterior pair oval, narrower, without occipital tentacle; nuchal organs not apparent. Peristomium well developed, not especially inflated (Fig. 2A); palps long, extending posteriorly for at least 12 setigers when preserved.

Setiger 1 biramous, with well-developed, conical noto- and neuropodial postsetal lamellae and setal fascicles. Notopodial lamellae from setiger 2, broader, thin, fused to basal part of branchiae; middle and posterior lamellae narrower, somewhat elliptical, free from basal part of branchiae, with numerous bacillary glands. Neuropodial lamellae thin, somewhat square-shaped (Fig. 2C).

Notosetae all capillaries, arranged in 2 rows, with setae of anterior row shorter, with granulated sheaths and smooth shafts; setae of setigers 1–3 with unusually large, conspicuous granules, imparting golden appearance to sheath (Fig. 2D); setae from anterior row of subsequent setigers with fine granules (Fig. 2E); setae of posterior row longer, with clear sheaths and smooth shafts (Fig. 2F). Neurosetae of setigers 1–10 similar to notosetae in structure and arrangement except for especially enlarged granules in anterior row; hooded hooks first present in posterior row, increasing to 6–7 over following setigers and replacing all capillaries in posterior row; anterior row of capillaries remaining intact through middle setigers, then becoming thinner and non-granulated in posterior setigers and finally lost entirely in far posterior setigers, hooks numbering 3–5 (Fig. 2C); hooks with long main fang surmounted by pair of long apical teeth and second pair of smaller teeth (Fig. 2G–H); without inferior sabre setae.

Branchiae from setiger 2, continuing to near posterior end, with numerous glands, especially prominent in middle and posterior setigers (Fig. 2A, C); single row of ciliated patches extending dorsally across each segment from bases of branchiae (Fig. 2A). Pygidium with 2 broad, ventrolateral lobes (Fig. 2B).

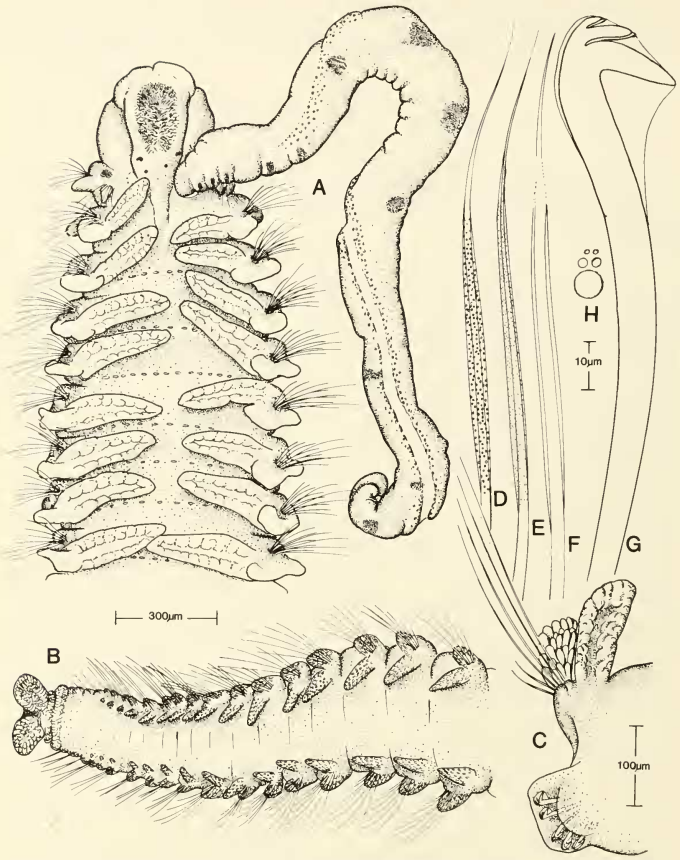

Fig. 2. *Microspio elegantula* (holotype, USNM 80490): A, Anterior end, dorsal view, left palp omitted; B, Posterior end, dorsal view; C, Left setiger 35 in anterior view; D, Notoseta from setiger 2; E, Notoseta from anterior row of middle setiger; F, Notoseta from posterior row of middle setiger; G, Hooded hook, lateral view, H, Diagram of hooded hook showing tooth arrangement.

Remarks.—*Microspio elegantula* superficially resembles *Microspio pigmentata* (Reish), originally described from southern California as *Spiophanes pigmentata* (Reish, 1959), in having a prominent middorsal pigment spot on the prostomium. The holotype of *S. pigmentata* has been examined. The hooded hooks have a main fang surmounted by a large unpaired apical tooth and a pair

of small teeth, the anterior margin of the prostomium is entire, posterior notopodia include numerous needlelike capillaries providing a distinct spinous appearance to the posterior end, and the pygidium has four anal cirri. *Microspio elegantula,* in contrast, has the main fang of the hooded hooks surmounted by two pairs of apical teeth, the prostomium is weakly incised on the anterior margin, the posterior notopodia include only long capillaries, instead of numerous needlelike spines, and the pygidium is formed of two broad lobes.

Distribution.—Known only from Wellington Harbor, intertidal in sand.

Spio readi, new species
Fig. 3

Material examined.—NEW ZEALAND, North Island, Wellington Harbor, Evans Bay, SW of Marina, intertidal in fine sand, 22 Aug 1974, coll. G. B. Read, holotype and paratype (USNM 80488–9).—NEW ZEALAND, South Island, off Otago Peninsula, coll. Portobello Marine Laboratory 1974 and 1975: R/V *Munida* Sta. Mu 74–179, 45°50.2'S, 170°48.4'E, 55 m, 1 specimen (NMNZ); Sta. Mu-74-197, 45°48.2'S, 170°49.6'E, 50 m, 1 specimen (NMNZ); Sta. Mu-75-71, 45°50'S, 170°55.5'E, 105 m, 1 specimen (NMNZ).

Description.—A moderate-sized species; holotype complete, 13.5 mm long and 1.0 mm wide for 54 setigerous segments. Color in alcohol: light tan, with large paired patches of reddish brown pigment located dorsally on peristomium and some anterior setigers, with additional dark reddish brown pigment on peristomium and as fine lines on some anterior setigers.

Prostomium narrow, entire on anterior margin, continuing posteriorly as indistinct caruncle to setiger 3, without occipital tentacle; 2 pairs of eyes, anterior pair cup-shaped, more widely spaced than posterior oval pair; transverse ciliated crest on setiger 3, with 2 large curved nuchal organs lateral to caruncle and transverse crest (Fig. 3A).

Setiger 1 well developed, with long straplike branchiae basally fused to notopodial postsetal lamellae. Branchiae long, ciliated on inner surface, meeting middorsally, continuing to posterior end, becoming short and stubby. Each segment with double row of cilia across dorsum between bases of branchiae (Fig. 3A). Notopodial postsetal lamellae elongate, with smooth rounded margin. Neuropodial postsetal lamellae elliptical.

Notosetae all capillaries, arranged in 2 rows, setae of anterior rows shorter, with finely granulated shafts and clear sheaths (Fig. 3C), setae of posterior rows longer, with non-granulated shafts and clear sheaths (Fig. 3D); superiormost capillaries of posterior rows longest. Neurosetae of setigers 1–10 similar to notosetae in arrangement and appearance; 9–10 bidentate hooded hooks replacing posterior row of capillaries from setiger 11, leaving anterior row of capillaries intact and adding third row of very fine, hairlike capillaries alternating with hooded hooks; 3–4 inferior sabre setae present in ventralmost location in setal fascicle; hooks reduced to 4–5 per fascicle in posterior setigers, hooks with main fang forming nearly right angle with shaft and apical tooth applied closely to main fang, with hood slightly inflated (Fig. 3E); sabre setae nongranulated, without sheath, with fine bristles from middle of seta to curved tip (Fig. 3F).

Pygidium with 4 broad, flattened anal cirri, ventral and ventrolateral, with broad dorsal gap; cirri with fine bacillary glands; anus terminal.

Remarks.—*Spio readi* is closely related to *S. filicornis* (O. F. Müller) reported

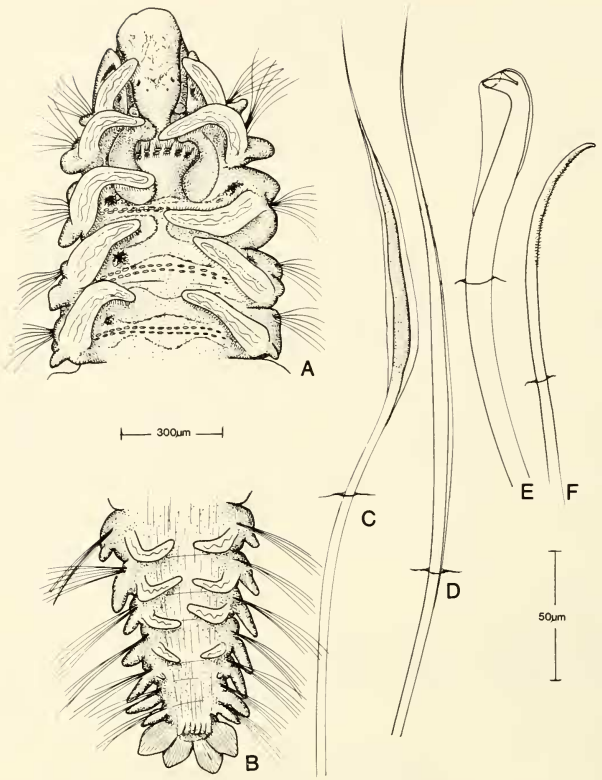

Fig. 3. *Spio readi* (holotype, USNM, 80488): A, Anterior end, dorsal view, palps omitted; B, Posterior end, dorsal view; C, Notoseta from anterior row; D, Notoseta from posterior row; E, Hooded hook; F, Sabre seta.

from worldwide localities in having an entire prostomium and bidentate hooded hooks. *Spio readi* differs from *S. filicornis* in having 4 ventrally located anal cirri instead of dorsal and ventral. According to N. J. Maciolek (Pers. comm., *S. filicornis* has 6 ventral glands on each segment, lacking in *S. readi*.

Etymology.—This species is named for Dr. Geoffrey Read, University of Wellington.

Distribution.—North and South Island of New Zealand, intertidal to 105 m.

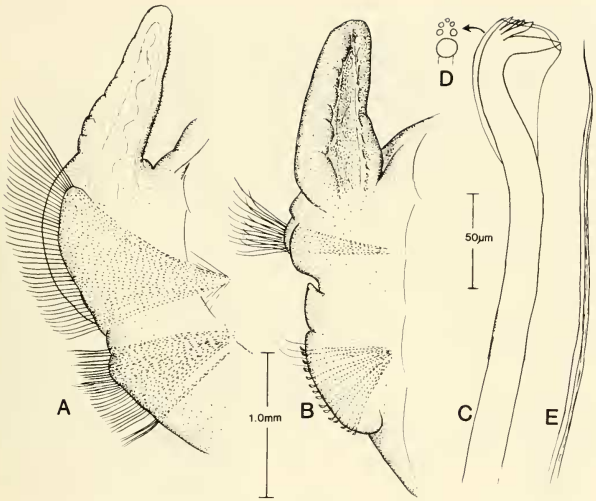

Fig. 4. *Spio aequalis* (syntype, BMNH ZB 1908.5.9.6): A, Right parapodium from setiger 12, anterior view; B, Same from setiger 150, anterior view; C, Hooded hook, lateral view; D, Frontal diagram of same, showing tooth arrangement; E, Neuropodial capillary from posterior setiger.

Spio aequalis Ehlers, 1904
Fig. 4

Spio aequalis Ehlers, 1904:40–42, pl. 5, figs. 18–21, pl. 6, figs. 1–4.

Material examined.—CHATHAM ISLAND, coll. Herr Schauinsland, 1896–97, syntype (BMNH ZB 1908.5.9.6).

Description.—A large species; syntype almost complete, coiled, measuring approximately 5 mm wide and 55 mm long for about 155 setigerous segments. Color in alcohol: gray. Tissue of syntype soft, tending to crumble, with considerable distortion of original prostomial features (see Remarks).

Anterior parapodia prominent, well developed; notopodial lamellae basally fused to branchiae, smoothly rounded, with dorsally directed presetal lobe (Fig. 4A); posterior notopodia reduced to rounded lobes (Fig. 4B). Anterior noto- and neuropodia broadly elliptical, becoming low setal tori posteriorly.

Anterior parapodia with numerous noto- and neurosetae in form of granulated capillaries arranged in 5 distinct rows, reduced to 2–3 rows after about setiger 15. Multidentate neuropodial hooded hooks from setiger 22, replacing posterior row of capillaries for about first 50 setigers, anterior row reduced to few superior, thin, nongranulated capillaries accompanying hooks (Fig. 4E); hooks numbering up to 15 per row in middle and posterior setigers; each with long main fang

surmounted by 5 apical teeth arranged in 2 pairs surmounted by single apical tooth (Fig. 4C–D); distinct inferior sabre setae lacking, although ventralmost neuropodial capillaries sometimes separated into small group.

Branchiae long, straplike in anterior setigers, becoming short, thick, squat, and distinctly set off from parapodia in posterior setigers. Pygidium unknown.

Remarks.—As depicted by Ehlers (1904, pl. 5, figs. 19–20), the prostomium flares anteriorly into two diverging lobes, between which is a small medial protrusion. The syntype is poorly preserved and the prostomium is narrow, conical anteriorly, continuing posteriorly to the margin of setiger 1. There is no evidence of eyes or occipital tentacle. There appears to be a weakly-developed peristomial wing present at the level of the palp scars.

Despite the poor condition of the syntype, there should be no trouble distinguishing *S. aequalis* in future collections. The species differs from all other described species of *Spio* in the numerous capillaries arranged in five rows in the anterior parapodia, combined with presence of multidentate hooded hooks and the short, thickened posterior branchiae. *Spio setosa* Verrill, 1873, from the east coast of North America has the capillaries arranged into three to four rows, bidentate hooded hooks and thin, straplike branchiae. *Spio singularis* Blake and Kudenov, 1978, from Queensland is similar to *S. aequalis* in having multidentate hooded hooks but the capillaries are arranged in only two rows.

Distribution.—Chatham Island.

Carazziella proberti, new species
Fig. 5

Material examined.—NEW ZEALAND, South Island, off Otago Peninsula, coll. Portobello Marine Laboratory, R/V *Munida* Sta. 75-72, 45°53.5′S, 170°59′E, 122 m, holotype (USNM 80495) and 2 paratypes (USNM 80496; NMNZ).

Description.—A moderate-sized species up to 5.5 mm long and 0.6 mm wide for 42 setigers. Color in alcohol: light brown.

Prostomium entire, rounded on anterior margin, widest at level of eyes, narrowing to blunt caruncle terminating in middle of setiger 2, followed by nuchal ridge to posterior margin of setiger 2 (Fig. 5A); without occipital tentacle; 2 pairs of eyes present, anterior pair cup-shaped, more widely spaced than oval-shaped posterior pair; lateral brown pigment spots located between eyes. Peristomium inflated, extending anteriorly beyond prostomium; palps moderately long, extending posteriorly for about 8–9 setigers.

Setiger 1 fused with peristomium, biramous, with unusually long notopodial postsetal lamellae, extending posteriorly to end of setiger 2 and bearing short fascicles of capillaries (Fig. 5A); neuropodia with conical postsetal lamellae and with large fascicles of capillaries arranged in 2 rows. Capillary noto- and neurosetae of setigers 2–4, and neurosetae of setigers 6–7 and notosetae of setiger 6 arranged in 2 rows; setae of anterior row shorter, with granulated shafts and clear, unilimbate sheaths (Fig. 5G), setae of posterior row longer, without granulations. Notosetae of far posterior setigers long, thin providing spinous appearance to posterior end (Fig. 5H). Neuropodia with bidentate hooded hooks from setiger 8, arranged in single row in anterior and middle setigers, with 5–6 hooks and 4 lower granulated capillaries; hooks with wide angle between main fang and shaft and reduced angle between apical tooth and main fang (Fig. 5F). Modified setiger 5 larger than

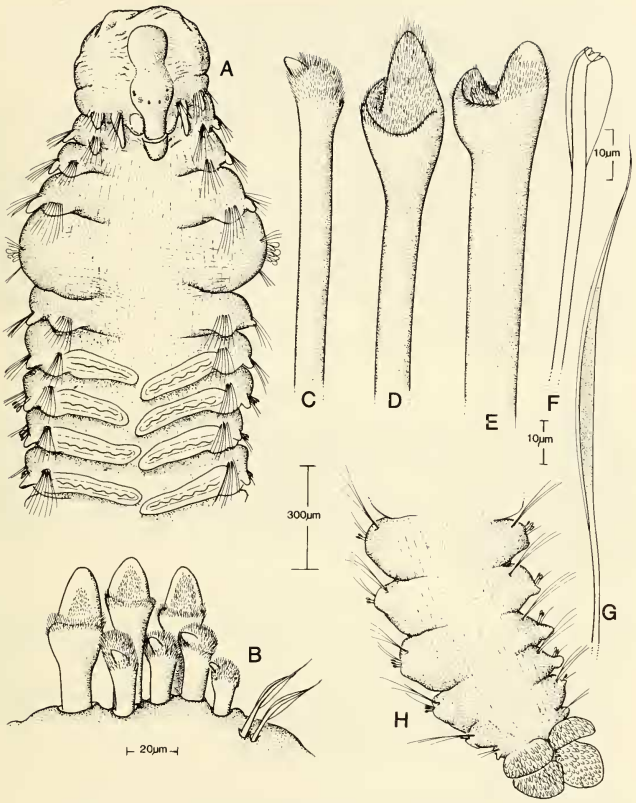

Fig. 5. *Carazziella proberti* (holotype, USNM 80495): A, Anterior end, dorsal view, palps omitted; B, Setae of setiger 5, Dorsal capillaries to right of major spines; C, Bristle-topped falcate spine from setiger 5; D–E, Bristle-topped non-falcate spines from same; F, Hooded hook, lateral view; G, Neuroseta from anterior row of anterior setiger; H, Posterior end in dorsal view.

preceeding and succeeding setigers, with few (0–3) dorsal short bilimbate capillaries (Fig. 5B), double curved row of 2 types of bristle-topped major spines and ventral fascicle of 7–8 long, granulated capillaries; major spines of 2 types: dorsal spines, falcate, with tooth emerging from dense cloak of bristles (Fig. 5C); ventral spines larger, with bristled tooth enclosed on one side by thick bristled shelf, with intermediate densely bristled concavity (Fig. D–E); bristles shorter when worn.

Dorsal postsetal lamellae on setiger 2 conical, becoming broad and platelike on setigers 3–4 and 6 (Fig. 5A); branchiae from setiger 7, fused with dorsal postsetal lamellae, continuing for 10–11 setigers and absent from posterior two-thirds of body. Branchiae elongated, extending to dorsal midline (Fig. 5A). Pygidium formed of 4 broad lobes, with numerous bacillary glands (Fig. 5H).

Remarks.—*Carazziella proberti* is the twelfth species to be described for the genus and appears to be most closely related to *C. phillipensis* Blake and Kudenov, 1978, from Victoria, Australia in having notosetae and long notopodial postsetal lamellae on setiger 1. *Carazziella phillipensis,* however, has an incised instead of an entire prostomium, narrow instead of broad pygidial lobes and the enlarged major spines of setiger 5 have a different form. (See Blake and Kudenov (1978) for the descriptions of *C. phillipensis* and the closely related *C. victoriensis* Blake and Kudenov. See Blake (1979) for a discussion of other species of *Carazziella*).

Etymology.—This species is named for Dr. Keith Probert of the New Zealand Oceanographic Institute.

Distribution.—South Island, New Zealand, 122 m.

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Literature Cited

Blake, J. A. 1979. Four new species of *Carazziella* (Polychaeta: Spionidae) from North and South America, with a redescription of two previously described forms.—Proceedings of the Biological Society of Washington 92(3):466–481.

———. 1983. Polychaetes of the family Spionidae from South America, Antarctica and adjacent seas and islands.—*In* Kornicker, L. (Ed.), Biology of Antarctic Seas XIV.—Antarctic Research Series 39:205–288. American Geophysical Union.

———, and J. D. Kudenov. 1978. The Spionidae (Polychaeta) from southeastern Australia and adjacent areas with a revision of the genera.—Memoirs of the National Museum of Victoria 39:171–280.

Day, J. H. 1967. A monograph on the Polychaeta of Southern Africa. Part 2. Sedentaria.—British Museum (Natural History) Publication No. 656:459–878.

Ehlers, E. 1904. Neuseelandische Anneliden.— Königlichen Gesellschaft der Wissenschaften zu Göttingen (Abh-Math-Phys), neue Folge 3(1):1–80, 9 plates.

Kudenov, J. D., and G. B. Read. 1977. *Axiothella serrata* n. sp., a maldanid polychaete from Porirua Harbour, New Zealand.—New Zealand Journal of Marine and Freshwater Research 11(4):697–702.

Rainer, S. 1973. *Polydora* and related genera (Polychaeta: Spionidae) from Otago waters.—Journal of the Royal Society of New Zealand 3:545–564.

Read, G. B. 1975. Systematics and biology of polydorid species (Polychaeta: Spionidae) from Wellington Harbour.—Journal of the Royal Society of New Zealand 5:395–419.

Reish, D. J. 1959. New species of Spionidae (Annelida, Polychaeta) from southern California.—Bulletin of the Southern California Academy of Sciences 58(1):11–16.

Verrill, A. E. 1873. Report on the invertebrate animals of Vineyard Sound and the adjacent waters, with an account of the physical characters of the region.—Reprint (Pp. i–vi, 295–778, pls. 1–38) from Report of Professor S. F. Baird, Commissioner of Fish and Fisheries for 1871 and 1872, Part I: I–XLVII, 1–852. Washington, Government Printing Office.

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